UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/556,795 | 04/25/2000 | AKIRA SHIMOKOHBE | 106096 | 8141 |

25944 7590 02/19/2003

OLIFF & BERRIDGE, PLC
P.O. BOX 19928
ALEXANDRIA, VA 22320

| EXAMINER | |
|---|---|
| SARKAR, ASOK K | |
| **ART UNIT** | **PAPER NUMBER** |
| 2829 | |

DATE MAILED: 02/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Offic  Acti n Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/556,795 | HATA ET AL. | |
| | **Examiner** | **Art Unit** | |
| | Asok K. Sarkar | 2829 | |

*-- The MAILING DATE of this communicati n appears on the cover sheet with the correspondence address --*

**Period f r Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *17 January 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disp sition of Claims**

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) *1 and 2* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *3-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on January 17, 2003 has been entered.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 3 – 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saotome, "Suparplastic Micro-forming of Microstructures", Proceedings, IEEE Workshop on Micro Electro Mechanical Systems, p 343 – 348,1994 in view of Barsoum, "Fundamentals of Ceramics", Chapter 9, p 311 – 317, McGraw-Hill Companies, Inc. 1997.

Regarding claim 3, Saotome discloses a method for producing a thin film-structure by the following steps:

- forming on a semiconductor die substrate a layer of an amorphous alloy material in columns 1 and 2 (see Fig.11);

- heating (forging) the layer of glass to a temperature within the supercooled liquid phase region and thereby deforming the layer to a given shape, and
- cooling the alloy to room temperature from the deformation temperature to stop deformation and form the structure in Fig. 11.

Saotome fails to expressly disclose the layer as a thin film, and exhibiting a viscous flow between $10^8 - 10^{13}$ Pa.S when heated at a temperature within the supercooled liquid phase region, heating the thin film to a temperature within the supercooled liquid phase region so that the film has a viscous flow between $10^8 - 10^{13}$ Pa.S and deforming the thin film to a given shape without the use of any external force.

However, Saotome's article in their results part in page 348 clearly points out that amorphous alloys in a supercooled liquid state can be used for micromechanical components/structures due to deformation under viscous flow.

The V-grove die is the substrate (Si) and the specimen on top is the amorphous thin film in Saotome's Fig. 1 in page 343. The dimension of the die throat and comparing it with the thickness of the specimen in Fig. 1 establishes that the amorphous specimen is a thin film. <u>The deformation of a material without any external force is inherent under viscous flow deformation</u>. Saotome is using the press for the deformation only to develop some theoretical deformation curves such as Fig. 9. A simple calculation and extrapolation of curves to very low tensile stress (such as stress due to the weight of the film without the use of any external pressure) would show that the viscous flow in Pa.S unit (viscosity within the supercooled phase region) to be within the $10^8 - 10^{13}$ Pa.S range.

Additionally, Barsoum teaches the fundamental properties of glass in terms of viscosity in paragraph 9.4 of Chapter 9 where range of viscosity for glassy/amorphous/ noncrystalline materials against temperature are shown in Fig. 9.10 in page 316 and the supercooled liquid properties of glass is shown in page 311.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to form a thin film of the amorphous/glassy alloy material in stead of the layer, which will inherently exhibit a viscous flow between $10^8 - 10^{13}$ Pa.S when heated at a temperature within the supercooled liquid phase region as taught by Barsoum and heat the alloy film to a temperature within the supercooled region at a viscous flow between $10^8 - 10^{13}$ Pa.S to deform the alloy without applying any external pressure and cooling the alloy to room temperature to retain the deformed structure as taught by Saotome. Heating at a higher temperature will tend to initiate melting behavior and deform the film, whereas at lower temperature, there will be practically no deformation. These are the inherent properties of glassy substances/materials as taught by Barsoum.

Regarding claim 4, Saotome discloses a thin film-structure where the amorphous alloy has a glass transition temperature within 200 - 600°C in column 1, page 346.

Saotome fails to disclose the temperature width of not less than 20°C in the supercooled liquid phase region.

Barsoum teaches that many glassy materials are known to possess a glass transition temperature within 200 - 600°C and a temperature width of not less than 20°C in the supercooled liquid phase region (see Fig. 9.10 in page 316).

Therefore, it would have been obvious at the time the invention was made to one of ordinary skill in the art to employ an amorphous material of glass having a glass transition temperature within 200 - 600°C and a temperature width of not less than 20°C in the supercooled liquid phase region since Barsoum teaches that amorphous materials with a glass transition temperature within 200 - 600°C and a temperature width of not less than 20°C in the supercooled liquid phase region is well known.

Regarding claim 5, deformation of the thin film of glass by its own weight is inherent in the disclosed method of Saotome.

4. Claims 6, 7 and 9 – 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saotome, "Suparplastic Micro-forming of Microstructures", Proceedings, IEEE Workshop on Micro Electro Mechanical Systems, p 343 – 348,1994 1994 in view of Barsoum, "Fundamentals of Ceramics", Chapter 9, p 311 – 317, McGraw-Hill Companies, Inc. 1997 as applied to claim 3 above, and further in view of Aksyuk, US 5,994,159.

Regarding claim 6, Saotome in view of Barsoum fails to teach deformation of thin film in the thin film structure by mechanical external force.

Aksyuk teaches a method of fabricating a thin film structure for micro-mechanical device in which the thin film beam 8 (see Fig. 1) is deformed by external mechanical force in column 6, line 22.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Saotome by mechanical external force to form the thin film structure as taught by Aksyuk.

Regarding claim 7, Saotome in view of Barsoum fails to teach deformation of thin film in the thin film structure by electrostatic external force.

Aksyuk teaches a method of fabricating a thin film structure for micro-mechanical device in which the thin film beam 8 (see Fig. 1) is deformed by external electrostatic force in column 5, line 62.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Werner by electrostatic external force to form the thin film structure as taught by Aksyuk.

Regarding claim 9, Saotome in view of Barsoum fails to teach deformation of thin film in the thin film structure by electrostatic external force.

Aksyuk teaches a method of fabricating a thin film structure for micro-mechanical device in which the thin film beam 8 (see Fig. 1) is deformed by external electrostatic force wherein an electrode layer made of conductive material is formed nearby the thin film, an opposite electrode being formed opposing the thin film and the thin film is deformed by the electrostatic external forces generated between the electrode layer and the opposite electrode in between column 5, line 61 and column 6, line 13.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Saotome by electrostatic external force to form the thin film structure wherein an electrode layer made of conductive material is formed nearby the thin film, an opposite electrode being formed opposing the thin film and the thin film is deformed by the electrostatic external forces generated between the electrode layer and the opposite electrode as taught by Aksyuk.

Regarding claim 10, Saotome in view of Barsoum fails to teach deformation of thin film in the thin film structure by magnetic external force.

Aksyuk teaches a method of fabricating a thin film structure for micro-mechanical device in which the thin film beam 8 (see Fig. 1) is deformed by external magnetic force in column 6, line 15.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Saotomer by magnetic external force to form the thin film structure as taught by Aksyuk.

Regarding claim 11, Saotome in view of Barsoum fails to teach deformation of thin film in the thin film structure by magnetic external force.

Aksyuk teaches a method of fabricating a thin film structure for micro-mechanical device in which the thin film beam 8 (see Fig. 1) is deformed by external electrostatic force wherein a magnetic layer made of a magnetic material is formed nearby the thin film, an opposite magnet being formed opposing the thin film and the thin film is deformed by the magnetic external forces generated between the magnetic layer and the opposite magnet in column 6, lines 14 - 20.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Saotome by applying magnetic external force to form the thin film structure wherein a magnetic layer made of a magnetic material is formed nearby the thin film, an opposite electrode being formed opposing the thin film and the thin film is deformed by the magnetic external forces generated between the magnetic layer and the opposite magnet as taught by Aksyuk.

Regarding claims 12 – 14, Saotome in view of Barsoum teaches deforming the thin film amorphous material by heating as described earlier with respect to claims 3 and 5.

Saotome in view of Barsoum fails to teach deforming the thin film by magnetic forces where the thin film is heated in the Curie Temperature range of the magnetic material such as Ni, Fe, Co and Mn, the Curie Temperature being in the range of 210 – 1200°C.

Aksyuk teaches deforming the thin film by magnetic forces generated by induced current but fails to expressly teach that the magnetic force can be generated by using magnetic materials such as Ni, Fe, Co and Mn having the Curie Temperature in the range of 210 – 1200°C.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Saotome by heating it within supercooled liquid region and applying magnetic external force to form the thin film structure wherein a magnetic layer is made of a common magnetic materials such as Ni, Fe, Co and Mn having the Curie Temperature in the range of 210 – 1200°C in stead of an electromagnet.

Regarding claims 15 – 18, Saotome in view of Barsoum teaches deforming the thin film amorphous material by heating as described earlier with respect to claims 3 and 5.

Regarding claim 15, Saotome in view of Barsoum fails to teach to form a subsidiary layer made of a material having a different thermal expansion coefficient from

that of the amorphous material nearby the film and the thin film is deformed by the stress resulting from the difference in thermal expansion coefficient between the thin film and the subsidiary layer generated in their interface. Saotome in view of Barsoum also fails to teach the magnitude of the thermal expansion coefficient, the thickness of the subsidiary layer and the make up of the subsidiary layer.

Aksyuk teaches a method of producing a thin film-structure where the beam is made up of two layers with one layer being polysilicon of a thickness of 1.5 micron and each layer having different linear thermal expansion and the deformation of the thin film is actuated by generating stress due to differential contraction of the two layers which is the result of different linear thermal expansion.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film modifying Saotome's method by using a subsidiary layer made of material having different linear thermal expansion than that of the amorphous thin film material and by simultaneous application of heat as taught by Aksyuk.

Regarding claims 16 – 18, Aksyuk teaches the thickness of the subsidiary layer in column 5, line 11 but fails to teach the magnitude of the thermal expansion coefficient, and the make up of the subsidiary layer except that it is polysilicon in column 5, line 10.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to judiciously adjust and control parameters of the subsidiary layer such as thermal expansion coefficient, which also depends on the composition and the

relative thickness of this layer with respect to the thin film during the deformation of an amorphous glassy thin film structure by the generation of stress due to thermal expansion mismatch through routine experimentation and optimization to achieve optimum benefits (see MPEP 2144.05) and it would not yield any unexpected results. Since the deformation is also induced by heat, it would be logical to combine the substrate material with the thin film material to provide an efficient deformation mechanism by the thermal expansion mismatch technique.

Regarding claims 19 – 22, Saotome in view of Barsoum teaches deforming the thin film amorphous material by heating as described earlier with respect to claims 3 and 5.

Regarding claim 19, Saotome in view of Barsoum fails to teach to form a subsidiary layer including an internal stress is formed nearby the film and the thin film is deformed by the stress resulting from the difference in internal stress between the thin film and the subsidiary layer generated in their interface. Saotome also fails to teach the magnitude of the compressive or tensile stress, the thickness of the subsidiary layer and the make up of the subsidiary layer.

Aksyuk teaches a method of producing a thin film-structure where the beam is made up of two layers with one layer being polysilicon of a thickness of 1.5 micron and each layer having high intrinsic strain and the deformation of the thin film is actuated due to internal stresses of the two in column 5, lines 19 - 33.

Regarding claims 20 – 22, Aksyuk fails to expressly disclose the magnitude of the stress in the subsidiary layer, the relative thickness with respect to the thin film and

the composition of the subsidiary layer made by mixing the substrate and the amorphous thin film.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to judiciously adjust and control parameters of the subsidiary layer such as the magnitude of the internal intrinsic stress which also depends on the composition and the relative thickness with respect to the thin film during the deformation of an amorphous glassy thin film structure by the generation of stress due to the difference in internal stress between them through routine experimentation and optimization to achieve optimum benefits (see MPEP 2144.05) and it would not yield any unexpected results. Since the deformation is also induced by heat, it would be logical to combine the substrate material with the thin film material to provide an efficient deformation mechanism by the internal stress differences between the two materials.

5. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Saotome, "Suparplastic Micro-forming of Microstructures", Proceedings, IEEE Workshop on Micro Electro Mechanical Systems, p 343 – 348,1994 in view of Barsoum, "Fundamentals of Ceramics", Chapter 9, p 311 – 317, McGraw-Hill Companies, Inc. 1997 and Aksyuk, US 5,994,159 as applied to claim 7 above, and further in view of Tregilgas, EP 0,762,176 A2

Saotome in view of Barsoum fails to teach deformation of thin film in the thin film structure by electrostatic external force.

Aksyuk teaches a method of fabricating a thin film structure for micro-mechanical device in which the thin film beam 8 (see Fig. 1) is deformed by external electrostatic

force wherein an electrode layer made of conductive material is formed nearby the thin film, an opposite electrode being formed opposing the thin film and the thin film is deformed by the electrostatic external forces generated between the electrode layer and the opposite electrode in between column 5, line 61 and column 6, line 13.

Aksyuk fails to teach that the thin film is made of a conductive material.

Tregilgas teaches a method of producing a thin film structure where they teach forming a beam 24 (see Fig. 3f) of an amorphous conductive material (nitrided aluminum or non-aluminum alloy) in column 1, lines 49 – 53.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to deform the thin film of Saotome by electrostatic external force to form the thin film structure as taught by Aksyuk wherein the thin film is made of conductive material as taught by Tregilgas and the thin film is deformed by the external electrostatic force generated between the thin film and the opposite electrode to form the thin film structure.

***Response to Arguments***

6. Applicant's arguments filed December 23, 2002 have been fully considered but they are not persuasive. The grounds for rejection of claims 3 – 22 are provided in the above-mentioned paragraphs. The actual viscous flow of the amorphous alloys can be determined and estimated from the figures provided by Saotome as has been discussed previously by extrapolating their curves in Fig. 1. Additionally, Saotome provides an example with the La-Al-Ni alloy and teaches that any material that exhibits supercooled liquid state in other words materials that are glass or amorphous can be subjected to

the micro-forming process for fabrication of micromechanical components (see abstract). Applicant's viscosity range $10^8$ to $10^{13}$ Pa.S is quite wide range and as shown by Barsoum in Fig. 9.10, all glassy materials fall within this range. This is also the case for amorphous metal alloys (see for example the reference by Busch, Appl. Phys. Lett., Vol. 72 (21), p 2695 – 2697,1998). All glassy materials inherently have a supercooled phase region and will deform under its own weight when heated in this region and will have viscosity range $10^8$ to $10^{13}$ Pa.S, which is the viscosity range in the supercooled phase region for glassy/amorphous/noncrystalline materials.

***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 703 308 2521. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kammie Cuneo can be reached on 703 308 1233. The fax phone numbers for the organization where this application or proceeding is assigned are 703 308 7722 for regular communications and 703 308 7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 4918.

Asok K. sarkar
February 10, 2003

KAMAND CUNEO
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800